NESTED CORE GAS TURBINE ENGINE

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application is a continuation from application Ser. No. 10/635,956 filed Aug. 7, 2003, now U.S. Pat. No. 6,988,357 which is a continuation from application Ser. No. 09/947,002, filed Sep. 5, 2001, now issued U.S. Pat. No. 6,647,707, which claims the benefit of U.S. Provisional Application No. 60/230,891, filed Sep. 5, 2000, which is incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to gas turbine engines and, more particularly, to a small gas turbine engine.

2. Previous Developments

At large power levels (thousands of horsepower), turbine engines are the most compact and lightest power systems available, and have completely taken over the market for large aircraft. However, scaled-down versions of these conventional gas turbine engines offer relatively poor power/weight ratio and high specific fuel consumption. FIG. **2**A illustrates that for small engines power/weight ratios versus rated power is low. FIG. **2**B illustrates that for small engines specific fuel consumption versus rated power is high. There are a variety of reasons why small gas turbine engines do not perform as well as the larger engines. These include

1. Reynolds Number Effects: Due to smaller characteristic dimensions, small compressor and turbine blades suffer from larger friction coefficients and greater aerodynamic losses.

2. Thickness/Chord Ratios: Due to physical difficulties in manufacturing very thin blades with adequate strength, airfoils used in small engines typically have larger thickness/chord ratios and relatively blunt leading edges. This causes larger aerodynamic losses due to profile drag and wave drag.

3. Large Relative Tip Clearances: Due to differences in relative centrifugal and thermal growths of rotors and shrouds, and the effects of scaling, small compressors and turbines suffer from larger relative tip clearances (ratios of absolute tip clearance to blade span). This in turn causes large tip leakage losses and lower component performance and efficiency.

4. Lower Cycle Pressure Ratios: Small turbine engines with high cycle pressures need extremely small blade heights. These are difficult to manufacture, have large tip clearance losses, and suffer from boundary layers occupying a large fraction of passage heights. Consequently, small engines are limited to low pressure ratios, resulting in lower specific power (per unit mass flow), and low cycle efficiency.

5. Lower Peak Cycle Temperatures: Large gas turbine engines can have intricate cooling passages in their large nozzle vanes and turbine blades. These convection, film and transpiration cooling schemes allow gas temperatures significantly higher than the structural capability of conventional turbine materials (metals), for high specific power and cycle efficiency. Similar cooling schemes are too complex and expensive for the small blade sizes of small gas turbines, causing them to be limited to lower temperatures and lower performance levels.

The present invention addresses these problems, and mitigates at least some of them, for improved power density and efficiency as will be described in greater detail below. Accordingly, amongst the objects of the present invention is to provide a lightweight/high-power density engine, having the ability to use military-standard high-energy fuels, such as JP8 or JP5. The engine has low observables including noise, smoke and infra-red signatures, and adequate life, to enable its use for reusable air vehicles, and affordable cost, to enable its use for expendable/attritable air vehicles. The engine can also be scaled up, as well as down, offering higher power/weight compared to current gas turbine engines of conventional design.

SUMMARY OF THE INVENTION

In accordance with the first embodiment of present invention, a gas turbine engine is provided. The gas turbine engine comprises a combustion chamber section, a turbine section, and a compressor section. The turbine section surrounds the combustion chamber section. The compressor section surrounds the turbine section.

In accordance with a second embodiment of the present invention, a gas turbine engine is provided. The gas turbine engine comprises an outer casing, a first rotor, and a second rotor. The first rotor is located in the outer casing. The second rotor is located in the outer casing. The first rotor has a first compression portion and a first turbine portion, the first compression portion being surrounded by the turbine portion of the first rotor.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and other features of the present invention are explained in the following description, taken in connection with the accompanying drawings, wherein:

FIGS. **1**–**1**A respectively are a schematic cross-sectional view and a schematic perspective cut-away view of a gas turbine engine incorporating features of the present invention in accordance with a first preferred embodiment;

FIG. **1**B is a perspective view of the gas turbine engine in FIG. **1**;

FIG. **1**C is a perspective view of the front section of an outer casing of the turbine engine in FIG. **1**;

FIG. **1**D is a perspective view of a front rotor of the turbine engine in FIG. **1**;

FIG. **1**E is a perspective view of a stator section of the turbine engine in FIG. **1**;

FIG. **1**F is a perspective view of a rear rotor of the turbine engine in FIG. **1**;

FIG. **1**G is a perspective cut-away view of a rear end portion of the turbine engine in FIG. **1**;

FIGS. **2**A–**2**B are graphs respectively illustrating power/weight ratios versus rated power, and specific fuel consumption (SFC) versus rated power for small engines of the prior art;

FIG. **3** is a cross-sectional view of a gas turbine engine in accordance with a second preferred embodiment of the present invention;

FIG. **4** is a graph showing variation of ignition delay time at a number of air temperatures with respect to pressure in accordance with the prior art;

FIGS. **5** and **6** are respectively schematic cross-sectional views of a conventional engine with centrifugal compressors and wrap-around burners, and a conventional engine with axial compressors and in-line burners;

FIGS. **7**–**10** respectively are schematic cross-sectional views of a turbo-jet engine, turbo-fan engine, high-bypass